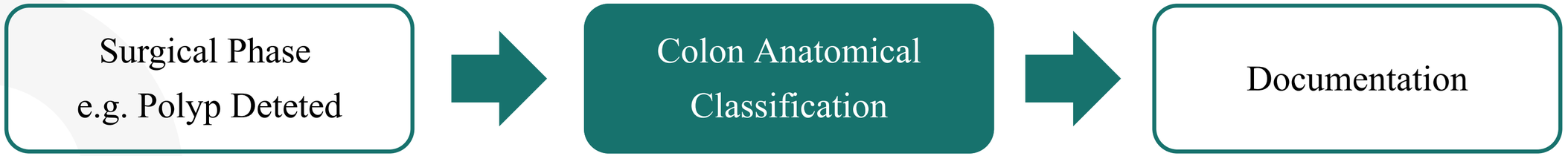
COLON ANATOMY LOCALIZATION

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Background and Motivation

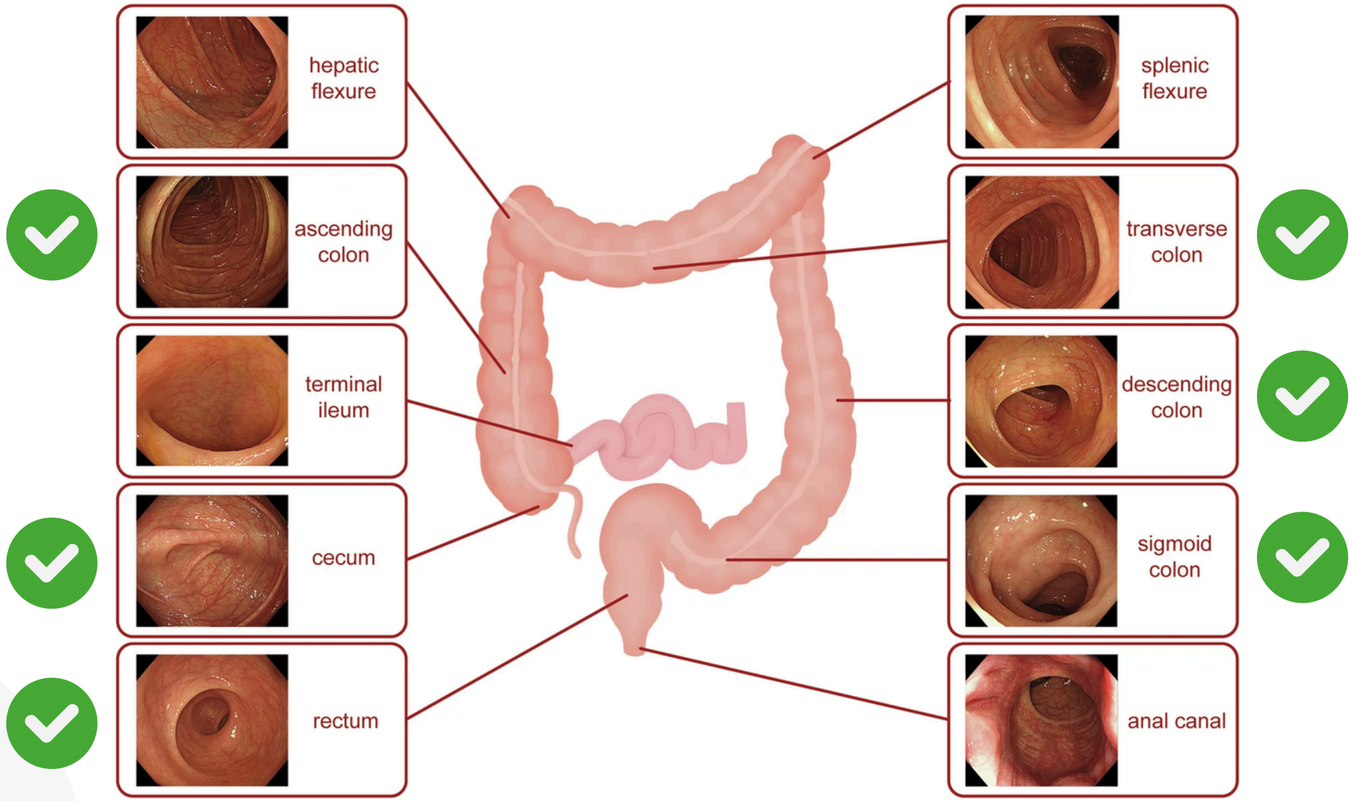
- **Colorectal cancer** is among the most common cancers.
  - Polyp → (can progress) → Pre-cancer → Cancer

- **Colonoscopy** is used to detect and remove polyps through phases like cleaning, detection, injection, and resection.
- **Documentation** of where a polyp is found or any other finding in colonoscopy procedure are **essential** for diagnosis and reporting.



Colon Anatomical Landmarks

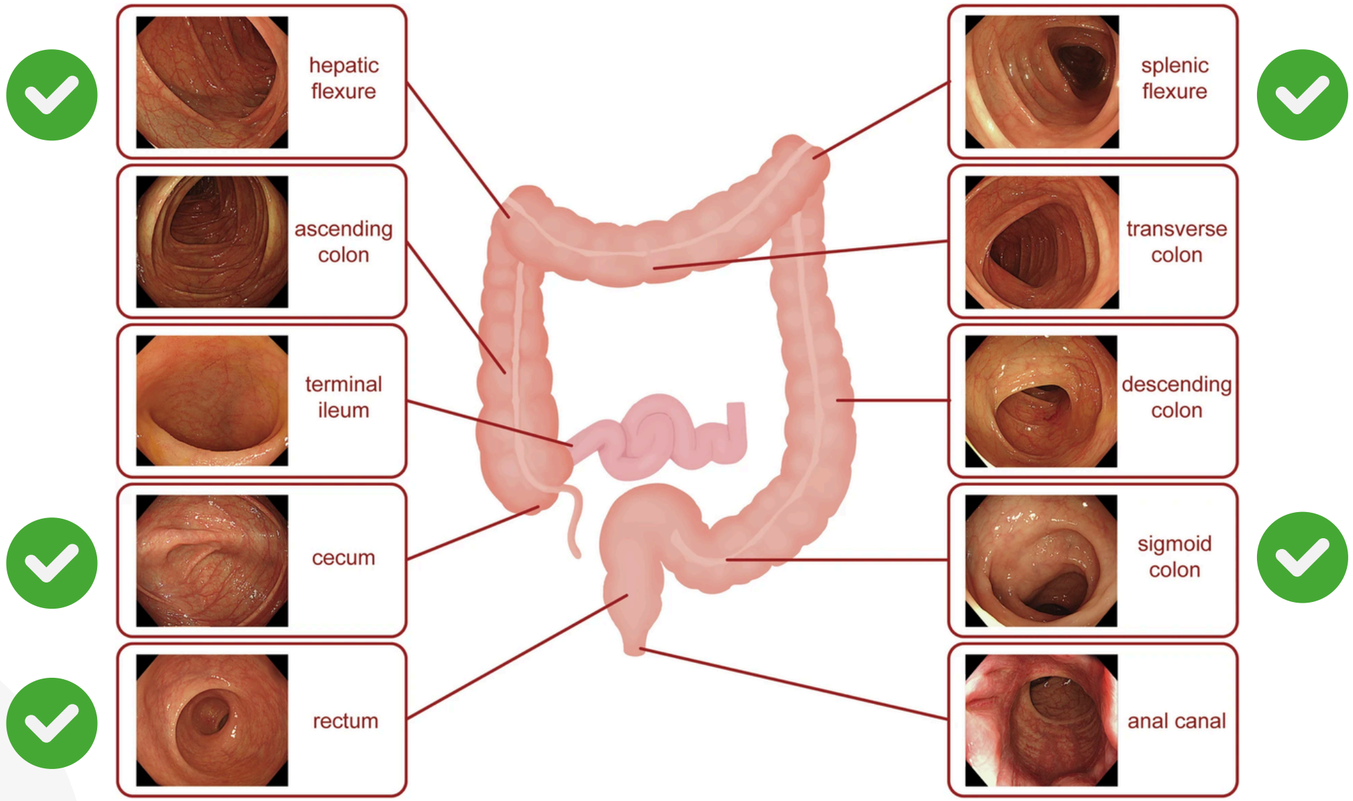
- **Goal**:
  - Identifying **anatomical colon landmarks (6 classes)**
    - By using **5 Landmarks**



Credit: Anatomical Landmark img from CAS-Colon

Colon Anatomical Landmarks

- **Goal**:
  - Identifying **anatomical colon landmarks (6 classes)**
    - By using **5 Landmarks**



Credit: Anatomical Landmark img from CAS-Colon

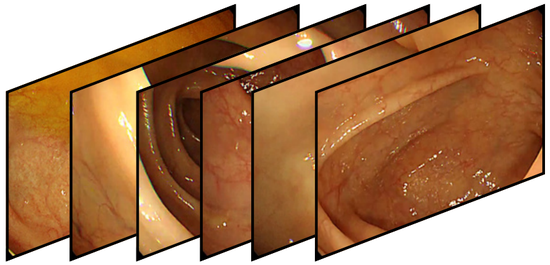
- Using prediction of:
  - Cecum
  - Hepatic Flexure
  - Splenic Flexure
  - Sigmoid Colon
  - Rectum

Challenges and Goals

- **Challenges**:
  - Visual similarity between adjacent locations
  - Sudden frame transitions cause unstable predictions
  - Blurry, bubble-covered, featureless frames reduce accuracy

Pipeline Methodology

Training Pipeline



75 Videos CAS Colonoscopy

extract images

Pre-processing:
Filter the images into 6 classes:
5 landmarks + ambiguous

Training:
with YOLO11s-cls

Inference Pipeline

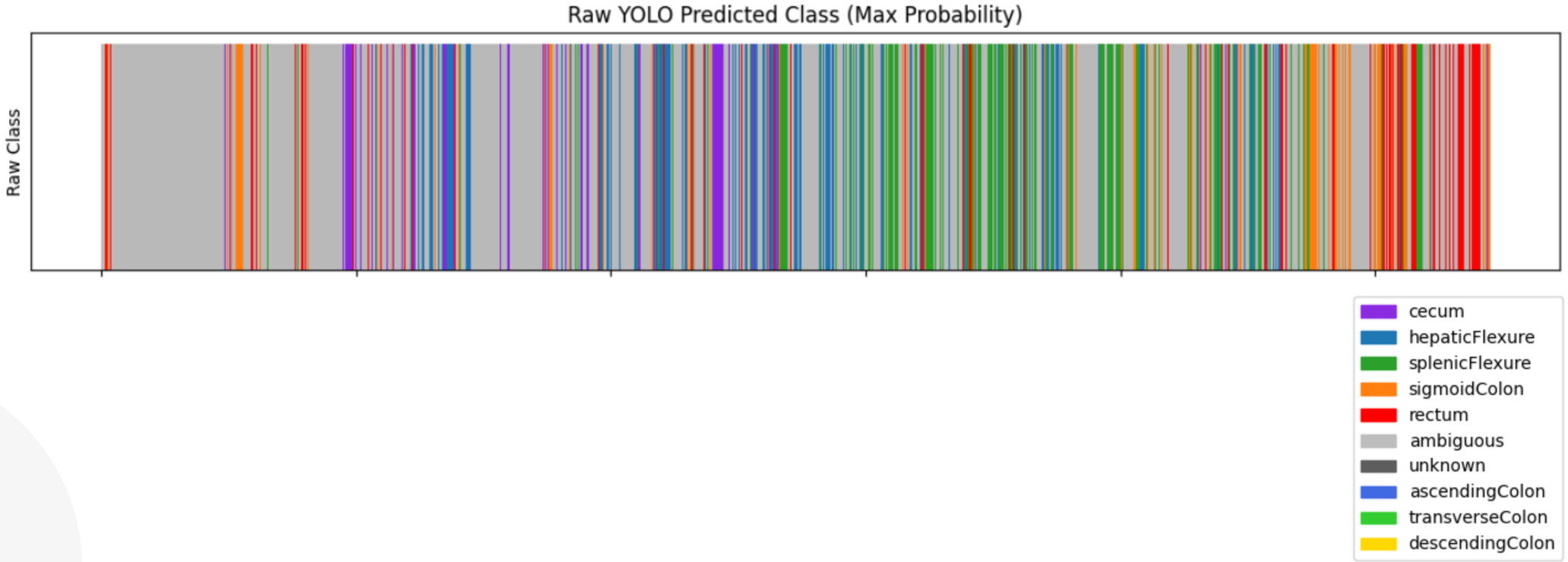
Frame-wise
Model Inference on Video

Viterbi Decoding
+ Select Segment Peak

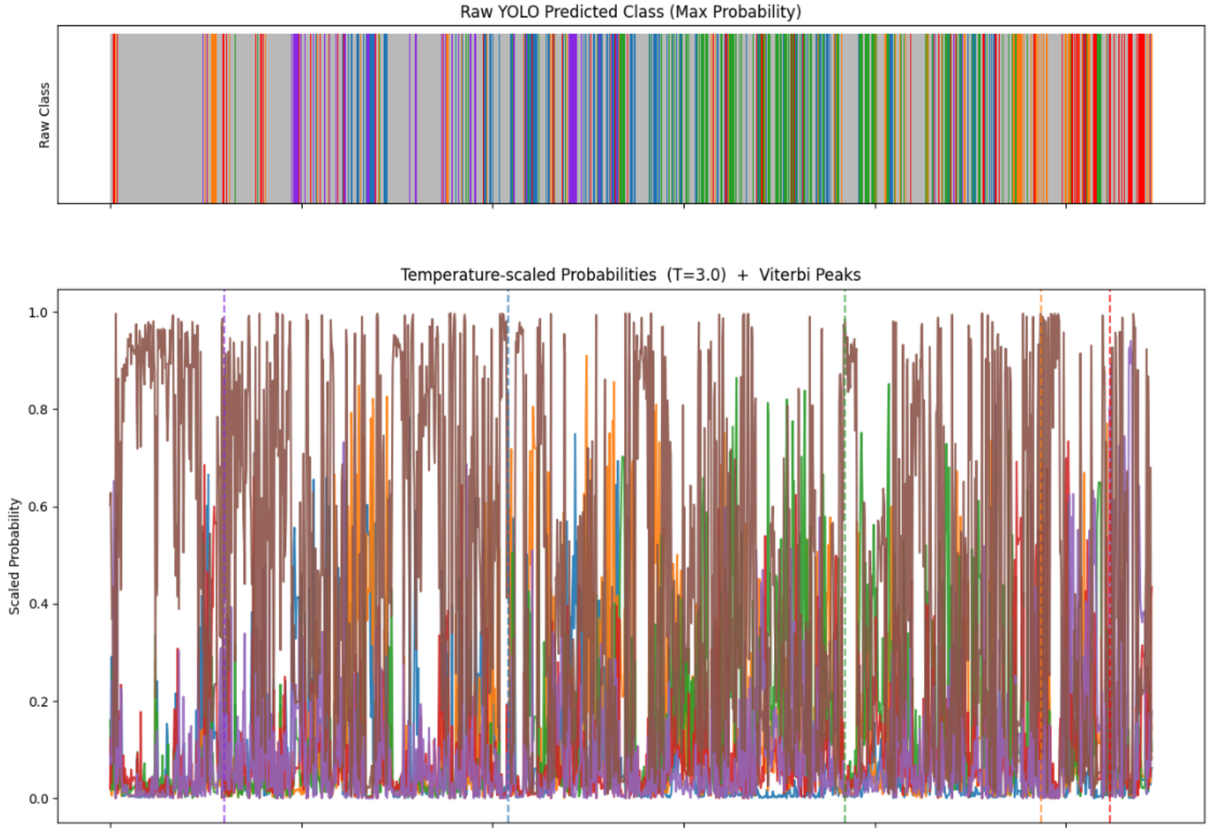
Rule-based
Segment Clustering

Single Frame-Wise Prediction

- **Model Backbone**: YOLO11s-cls
  - Used to train dataset of 5 anatomical landmarks
  - Output: single frame-wise prediction
  - Challenges: Frame-by-frame prediction can be noisy (too many jumps)



Post-Processing Inference

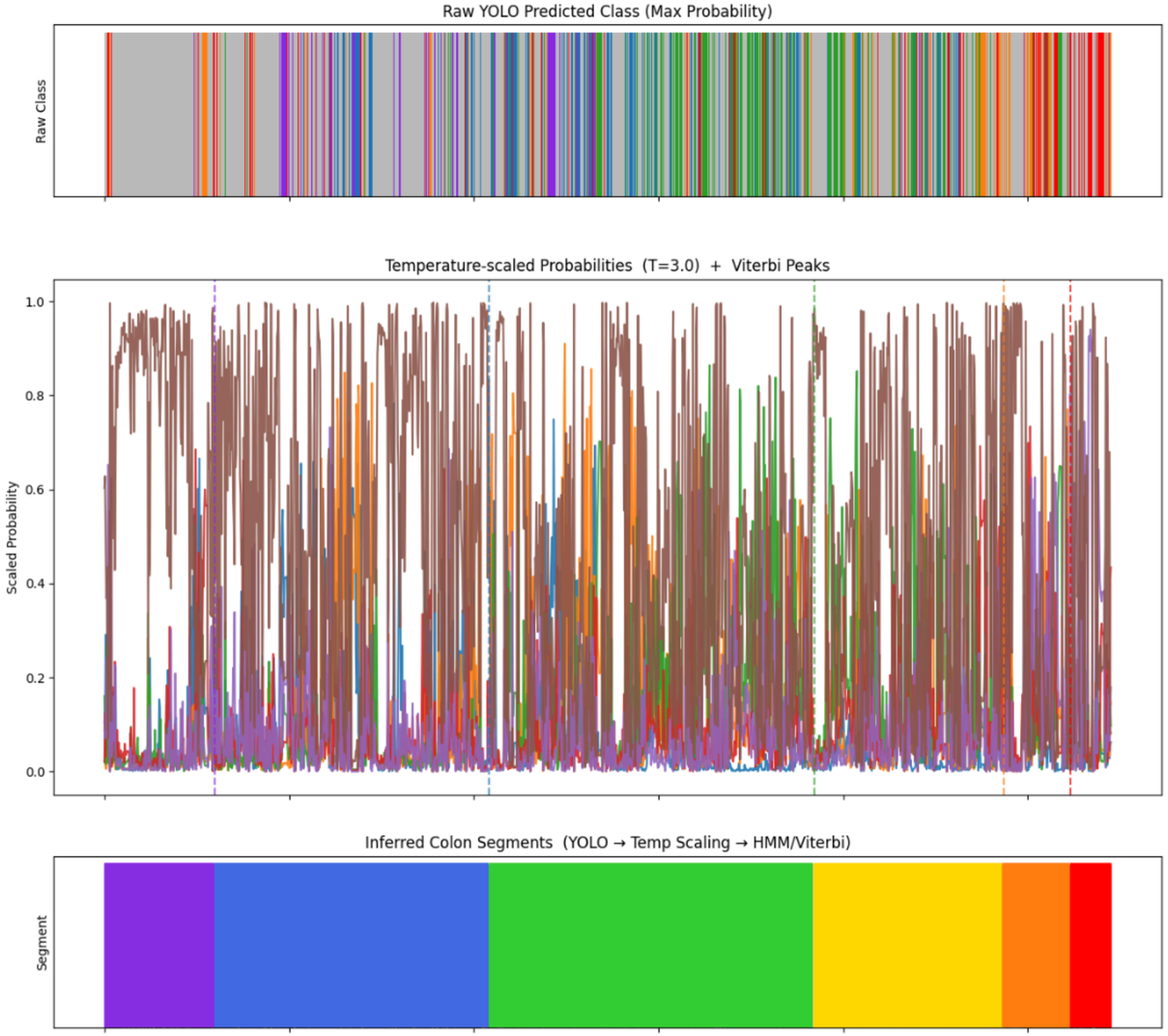


- **Viterbi Decoding**
  - Anatomical order constraints
  - (no jumping from sigmoid → cecum)

- **Boundary / Peak Detection (label transitions)**

- **Rule-based grouping**
  - Before cecum = cecum
  - Between cecum and hepaticFlexure = ascendingColon
  - Between hepaticFlexure and splenicFlexure = transverseColon
  - Between splenicFlexure and sigmoidColon = descendingColon
  - Between sigmoidColon and rectum = sigmoidColon
  - After rectum = rectum

Result



- **HMM/Viterbi Decoding**
  - Anatomical order constraints
  - (no jumping from sigmoid → cecum)

- **Boundary / Peak Detection (label transitions)**

- **Rule-based grouping**
  - Before cecum = cecum
  - Between cecum and hepaticFlexure = ascendingColon
  - Between hepaticFlexure and splenicFlexure = transverseColon
  - Between splenicFlexure and sigmoidColon = descendingColon
  - Between sigmoidColon and rectum = sigmoidColon
  - After rectum = rectum

Analysis and Future Work

- **Analysis:**
  - A limitation of this approach is that it assumes the colonoscopy **progresses in one direction**.
  - In reality, the scope often **moves back and forth** between different regions.

- **Future Work:**
  - To solve the limitation above

Summary

- **Methods:**
  - YOLO11s-cls
  - HMM/Viterbi Decoding
  - Rule-based Clustering

- **Steps**
  - Use filtered extracted images to train the model using YOLO11s-cls
  - Video frames are processed into predictions, temporally refined with Viterbi decoding
  - Selected peak used to cluster segment into anatomically ordered colon regions.

- **Result**
  - Colon anatomy localization from video under a single forward (withdrawal) progression.

THANK YOU